UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/003,358	11/14/2001	Fang-Cheng Chang	NTI-022	4650

			EXAMINER
29477	7590	08/11/2004	LIN, SUN J

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _14 November 2001_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-27_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-27_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _11/14/2001_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _2_.

4)☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

DETAILED ACTION

1.   This office action is in response to application 10/003,358 filed on 11/14/2001.
Claims 1 – 27 remain pending in the application.

Specification Objections

2.   The specification is objected to because of following informalities:

Paragraph 0004, line 4, change "location" to —locations—.

Appropriate correction is required.

Claim Objections

3.   Claims listed below are objected to because of the following informalities:

Claim 1, line 6, in front of "inspection" insert —the—.

Claim 1, line 6, change "images" to —image—.

Claim 6, line 6, delete —wafer—.

Appropriate correction is required.

Claim Rejections - 35 USC § 103(a)

4.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all
obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth
> in section 102 of this title, if the differences between the subject matter sought to be patented and the prior
> art are such that the subject matter as a whole would have been obvious at the time the invention was
> made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall
> not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459
(1966), that are applied for establishing a background for determining obviousness under
35 U.S.C. 103(a) are summarized as follows:

    (1).   Determining the scope and contents of the prior art.
    (2).   Ascertaining the differences between the prior art and the claims at issue.
    (3).   Resolving the level of ordinary skill in the pertinent art.
    (4).   Considering objective evidence present in the application indicating obviousness or
           nonobviousness.

5   Claims 1 – 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S.
Patent No. 6,272,236 B1 to _Pierrat et al._ in view of U.S. Patent No. 6,057,063 to _Liebmann_
_et al._

6.   As to Claim 1, _Pierrat et al._ show and teach the following subject matter:

- _Image simulation_ procedures capable of detecting _anticipate defects_ on a mask
  – [col. 3, line 14 – 26]; _capturing_ (i.e., _generating_) _inspection image_ of _a portion_
  (e.g., _critical feature_) of the mask and creating a _simulation_ of _resist_ to be formed
  (on a wafer) according to the _inspection image_ – [col. 3, line 49 – 51]; Notice that
  the portion of mask containing a _critical feature_, which requires special attention,
  is an _area of interest (AOI)_; Therefore, an _AOI_ (_area of mask containing a critical_
  feature portion) is identified first, and then an _inspection image_ of the _critical_
  feature portion in the _AOI_ is _generated_ for use in the simulation;
- _Mask pattern_ is manufactured from _original (design) pattern data_ – [col. 3, line
  45 – 46];
- _Mask inspection machine_ can be applied to any particular type of masks, which
  include **_photomask_** and **_phase shifting mask_** – [col. 6, line 19 – 27]; Notice
  that a _photomask_ is designed for a _desired design pattern_, including a _critical_
  feature portion in an AOI, it is manufactured utilizing _original (design) pattern_
  data – [Fig. 3]; _Pattern data_ is a _geometry information_ regarding desired pattern
  design. _Photomask_ is a _design geometry information_.

        Pierrat et al. do not disclose information about construction of _phase shifting mask_
and its relationship with a (critical) feature. But _Liebmann et al._ show and teach the
following subject matter:

- A process for creating and verifying a design of _phase-shifted mask_ – [title;
  abstract];
- _Phase-shifted masks_ are deployed to (critical) features in a chip design that require
  phase shifting – [abstract; col. 3, line 59 – 62];
- _Phase-shifted mask_ contains _colored phase regions_, which are created on _opposite_
  sides of features – [abstract; Fig. 1 – Fig. 4]; _Proper phase termination_ (e.g., 180°
  out of phase) of the _phase regions_ is ensured based upon _space constraints_ of a
  phase-shifted mask technique utilized – [abstract].

In addition, _Liebmann et al._ also teach that phase shifted mask (PSM) lithography is applied to improve the _lithographic process latitude_ in order to replicate _small image_ (i.e., _critical feature_) in a chip design – [col. 2, line 34 – 56].

Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to have applied the teachings of _Liebmann et al._ in utilizing _phase shifted mask_ to improve the _lithographic process latitude_ in order to replicate _small image_ (i.e., _critical feature_) in the AOI.

Notice that _Liebmann et al._ also show and teach the following subject matter:

- a _photomask design_ showing _(critical) feature edges_ – [Fig. 1];
- _phase regions_ of _phase shifted masks_, which are deployed around the _photomask_ of each _(critical) feature edges_ – [Fig. 2];

Therefore, in order to appropriately deploy the appropriate _phase regions_ of a _phase shifting mask_ around an AOI having a _critical feature_, the _photomask_ (_design geometry information_) regarding an area outside the AOI should be provided and modified to accommodate the _phase regions_.

Combining the teachings of _Liebmann et al._ and _Pierrat et al._, the following subject matter is disclosed utilizing Fig. 1 of _Pierrat et al._:

- Simulation of a _critical feature_ in the AOI is performed based on the _inspection image_ of the AOI and the _phase regions_ of a _phase shifting mask_ deployed around the AOI according to _design geometry information_ (_photomask_) in Step 180 – [Fig. 1]; Notice that the image simulation of _desired design pattern_ of the critical feature under study is performed in Step 185.

For reference purposes, the explanations given above in response to Claim 1 are called **[Response A]** hereinafter.

7.   As to Claim 18, reasons are included in **[Response A]** given above.

8.   As to Claim 27, reasons are included in **[Response A]** given above. Notice that based
on the explanations included in **[Response A]**, a computer program product can be
generated to perform the subject matter as recited in Claim 27.

9.   As to Claim 25, reasons are included in **[Response A]** given above. Notice that
accuracy of the *critical feature* is based on the following factors:

- a *mask inspection image*, which has a *defined area* (i.e., *area defined the
  critical feature*); and
- *design geometry information* (*photomask*) outside the defined area, where
  appropriate *phase regions* of *phase shifting mask* are deployed around the
  defined area.

     For reference purposes, the explanations given above in response to Claim 25 are
called **[Response B]** hereinafter.

10.   As to Claims 2 and 19, *modifying data* include *colors* and *layout data* of *phase
regions* for use in the *phase shifting mask* around the *critical feature* in the AOI in order to
achieve appropriate phase shifting.   Notice that the *colors* of phase regions are set to
control the degree of phase shifting (e.g., 180° out of phase) between the phase regions.

11.   As to Claims 3 and 20, *modifying data* includes **generating** *phase regions* of *phase
shifting mask* outside and around the AOI and **combining** the *inspecting image* of *critical
feature* and the *phase regions* of *phase shifting mask*.   Notice that an image generated by
the *phase regions* of *phase shifting mask* is a *phase shifting image*, which is a *virtual
image*.

     For reference purposes, the explanations given above in response to Claims 3 and
20 are called **[Response C]** hereinafter.

12.   As to Claim 4, as explained in **[Response A]** given above, the *simulation 180* is
performed on the *combined images* 160.2, which is a combination of the *inspecting image*
and the image of *phase regions* of *phase shifting mask* received from Step130 – [Fig. 1].

     For reference purposes, the explanations given above in response to Claim 4 are
called **[Response D]** hereinafter.

13.   As to Claims 5, 6 and 21, reasons are included in **[Response C]** and **[Response D]** given above.

14.   As to Claims 7 and 22, *Pierrat et al.* show and teach that the *photomask* (*design geometry information*) of an *entire original pattern design* can be *digitized* to acquire an *inspection data* (*digitized image data*), which is sent to *image simulation circuitry* – [Fig. 1; Fig. 3; col. 5, line 45 – 50]. Notice that a *digitized image* is a *bit map image*, which is made of *bits* "1" and bit "0".

For reference purposes, the explanations given above in response to Claims 7 and 22 are called **[Response E]** hereinafter.

15.   As to Claims 8 and 23, the *design geometry information* of a *photomask* of an entire original pattern design includes a *(critical) feature* in an AOI. Therefore, the *design geometry information* of a *photomask* of an entire original pattern design includes extending geometries of the *(critical) feature* in the *AOI* – [*Liebmann et al.*; Fig. 1 – Fig. 5].

16.   As to Claims 9 and 10, as explained in **[Response A]** given above, providing *design geometry information* (*photomask*) includes accessing information regarding another mask, which is a *phase shifting mask* – [*Liebmann et al.*; Fig. 1 – Fig. 5].

For reference purposes, the explanations given above in response to Claims 9 and 10 are called **[Response F]** hereinafter.

17.   As to Claim 24, reasons are included in **[Response F]** given above. Notice that, in design of an appropriate *phase shifting mask*, *database information* regarding *phase shifting (i.e., colors)* and *sizes* for use in design of *phase regions* of the *phase shifting mask* needs to be accessed.

For reference purposes, the explanations given above in response to Claims 9 and 24 are called **[Response G]** hereinafter.

18.   As to Claim 26, in addition to reasons included in **[Response A]**, **[Response B]**, **[Response C]**, and **[Response D]** given above, _Liebmann et al._ and _Pierrat et al._ show and teach the following subject matter:

- _(Photomask) image simulation_ obtained in Step185 is based on _desired pattern database_, it provides a _first accuracy_ – [_Pierrat et al._ – Fig. 1];
- _Mask inspection image_ with _phase shifting mask_ generated in Step180 provides an _improved accuracy_ – [_Pierrat et al._ – Fig. 1; _Liebmann et al._, col. 2, line 34 – 40];
- _Improved accuracy_ of _image simulation 180_ is compared with _first accuracy_ in _image simulation 185_ to detect defect in 140 – [_Pierrat et al._ – Fig. 1].

19.   As to Claim 11, in addition to reasons included in **[Response A] and [Response G]** given above, _Pierrat et al._ teach that the _inspection image_ is a _digitized image_ generated from an _inspection tool_ (e.g., _scanning electron microscope_ SEM) – [col. 5, line 8 – 18; col. 5, line 45 - 50]. Notice that the _Inspection image_ is _first information_ relating to a _first area_ (i.e., _AOI_) – **[Response A]**. _Second information_ is obtained from _design geometry information_ (i.e., _design file_). The _Second information_ is related to area of _phase region_ (i.e., _second area_) of _phase shifting mask_ outside the _first area_ (_AOI_) – **[Response G]**.

20.   As to Claim 12, reasons are included in **[Response E]** given above.

21.   As to Claims 13 and 14, _Liebmann et al._ show in Fig. 1 and Fig. 2 and teach that the _second area_ (_phase region_) for use in designing a _phase shifting mask_ is defined by a predetermined _spacing_ (i.e., _distance_) or a plurality of _spacings_ (i.e., _distances_) from a perimeter of the _first area_ (i.e., _feature edge_ under study) dependent upon _structure_ and _size_ of the critical feature edge in the _first area._

22.   As to Claim 15, the _first area_ is a _feature_ in any _AOI_. The _first area_ (_feature_) can be _defined_ by an _engineer_ (i.e., _user_) by choosing an AOI when operating the _simulation engine_.

23.   As to Claim 16, _Liebmann et al._ teach the following subject matter:

- *Phase shifted mask design system* for manufacturing VLSI circuit device – [abstract];

- Mask process for creating and verifying a design of *phase shifted mask* utilizing at least one *phase shift region* employing a *computer-aided design system* – [abstract]; Notice that the *phase shifted mask design system* is a *computer-aided design system*; The *second area* (*phase region*) can be defined by the *phase shifted mask design system*

- *Critical features* in a design of the *phase shifted mask* (for a VLSI circuit device) that required *phase shifting* are located – [abstract]; Notice that the *first area* (i.e., *critical feature*) is *located* (i.e., *defined*) by the *phase shifted mask design system*.

24.   As to Claim 17, as explained in **[Response A]** given above, the *first area* relates to *photomask* (i.e., *first mask*) of a *desired pattern* of a *critical feature* and the *second area* (*phase regions*) relates to *phase shifting mask* (i.e., *second mask*) associated with the *photomask* (*first mask*).

Conclusion

25.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sun J. Lin whose telephone number is (571) 272-1899. The examiner can normally be reached on Monday-Friday (9:00AM-6:00PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1907. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

Sun James Lin
Art Unit 2825
August 9, 2004